THE TAUNTON BAY ASSESSMENT

A Report to the Maine Legislature Marine Resources Committee for Consideration of the 2000-2005 Dragging Prohibition

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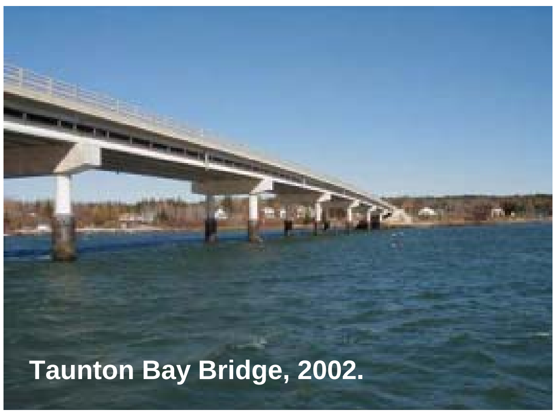
BACKGROUND

Taunton, Egypt, and Hog Bays (collectively referred to as "Taunton Bay") comprise a 3,282-acre (1,329 ha) estuary located at the head of Frenchman's Bay, in mid-coastal Hancock County. Since colonization, this shallow embayment and its immediate surroundings have supported a variety of human activities including finfish/shellfish harvesting, logging, agriculture, shipbuilding, quarrying, and silver mining (see the Friends of Taunton Bay, 1991 for a comprehensive review). Today the Bay's marine-based industries include fisheries for lobster (*Homarus americanus*), crabs (*Cancer* spp.), clams (Bivalva), mussels (*Mytilus edulis*), marine worms (Polychaeta), and marine algae. Aside from its support to the local economy, Taunton Bay has also been recognized for a number of exemplary ecological features, including extensive eelgrass (*Zostera marina*) beds, a shorebird staging area of statewide importance, bald eagle (*Haliaeetus leucocephalus*) nest sites, and the northernmost documented horseshoe crab (*Limulus polyphemus*) breeding ground.


Taunton Bay Bridge, 2002.

Over the years, the low clearance height of the pre-existing Route 1 Bridge limited commercial shellfish dragging in Taunton Bay to occasional use by small vessels. In 2000, public concern that a replacement to the old bridge would facilitate passage of larger boats and more frequent dragging prompted the Maine Legislature to enact a five-year moratorium (Title 12, §6959) prohibiting the use of drags in the Bay. Attending this legislation was a mandate that instructed:

No later than February 1, 2004, the Department of Marine Resources shall submit a report to the joint standing committee of the Legislature having jurisdiction over marine resources matters regarding the impact of the Maine Revised Statutes, Title 12, section 6959 on the Taunton River area and shall assess whether the prohibition contained in that section of law remains necessary or advisable. The joint standing committee of the Legislature having jurisdiction over marine resources matters may report out a bill to the Second Regular Session of the 121st Legislature to implement the department's recommendations.

Thus, the Taunton Bay Assessment was initiated to explore the impacts of dragging in the Bay in preparation for reconsideration of the issue in 2005.

Project Development and Objectives

Our primary goal was to provide the legislature and local citizens with a defensible rationale for subsequent decision making regarding the dragging issue. We also hoped that this work might facilitate the development of a comprehensive management strategy for the Bay. Though a systematic project workplan had not yet been developed, we initiated seafloor mapping in Taunton Bay in August 2001 to provide a basic (but often lacking) understanding of benthic community distribution throughout the Bay. In February 2002 a small collaborative group consisting of DMR Ecology Division staff, Friends of Taunton Bay members, and industry representatives refined an assessment plan intended to address high priority questions directly related to dragging in the Bay. By providing baseline data, this plan also laid the groundwork for addressing management considerations other than dragging. Components of the workplan focused on development of 1) a general characterization of estuary's benthic environments and uses, 2) research/inventories targeting select ecological attributes, and 3) a dragging experiment. Distinct projects driven by the Assessment included (principal cooperators in parentheses):

- Seabed mapping (Maine DMR/local fishermen)
- Characterization of the Bay's dragging history (Maine DMR/local fishermen)
- Eelgrass distributional changes (Maine DMR)
- Intertidal community characterizations (Maine Maritime Academy)
- Horseshoe crab seasonal movements (Maine DMR/Friends of Taunton Bay)
- Shallow subtidal fish communities (Maine DMR)
- Mussel dragging experiment (Maine DMR/Univ. of Maine/local fishermen)

ASSESSMENT COMPONENTS

Benthic Characterization

Seabed Mapping

Effective fisheries management requires not only an understanding of distributions and abundance of targeted resources, but also environmental features/processes that influence target species populations. Cover-type mapping or aerial imagery are some of the first tools used by terrestrial ecologists/wildlife managers in assessing the status of a given area. Likewise, seabed mapping is indispensable to coastal/fisheries managers who must characterize the distribution and spatial extent of specific community types, substrates, or other benthic variables that comprise habitat for marine organisms. Our mapping featured the use of RoxAnn™ , an acoustic seabed classification system that allowed us to identify and map Taunton Bay's channel areas in 2001 and 2002. Besides providing fundamental data necessary for subsequent management efforts, this work afforded us a chance to identify areas likely to be targeted by harvesters should dragging resume. One product of this work was a seabed map (Appendix A) indicating the distribution of various bottom types. The following findings related directly to the dragging issue:

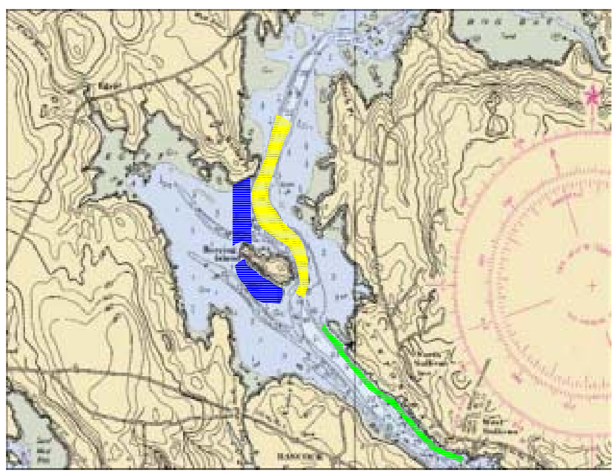
- Combined with underwater video data, the map suggested that bottom conditions in the lower main channel were consistent with green sea urchin (*Stronglyocentrotus droebachiensis*), and possibly sea scallop (*Placopecten magellanicus*) habitat, whereas somewhat finer upper channel substrates were

more indicative of scallop grounds. However, observations of either species during video work were uncommon.
- We encountered mussels frequently during our work in the subtidal flats, but subsequent observations suggested that the Bay supported few areas of market-quality mussels. Seed-stock, which can be collected and transplanted to grow-out sites outside of the Bay, may represent another harvestable mussel resource.
- Despite the scarcity of marketable mussels, effort to harvest them may be expended as we observed during the Summer-Winter 2003, when drag fishermen resorted to hand-raking this resource due to unfavorable conditions elsewhere.

Dragging History

Vessel reporting for inshore shellfish harvesters that would allow assessments of where, when, and how often fishing pressure occurs is non-existent. We relied on interviews with local harvesters and Marine Patrol Officers to reconstruct a crude history of dragging in the Bay over the last 20 years. Summarized results are as follows:

- Other than the one documented incident of urchin dragging after the closure, scallops and urchins were dragged for over 20 years and about 3 years, respectively, until stocks dwindled in the late 1990s.



Key

Mussel harvest area (1984-1985)

Scallop harvest area (1980-1997)

Urchin harvest area (1993-1996)

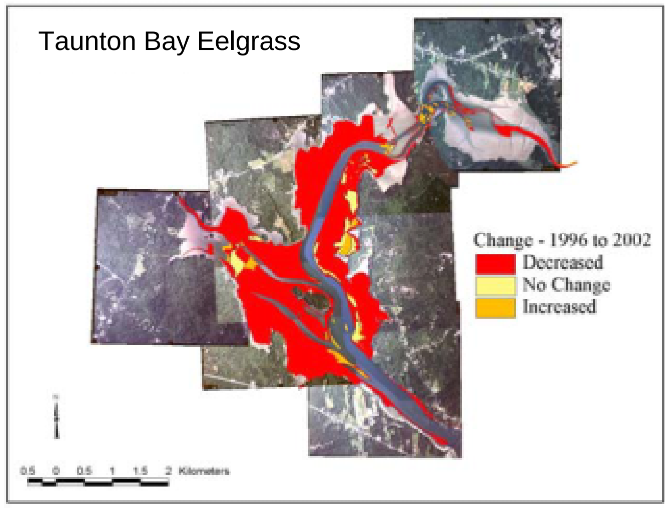
- Local fishermen dragged for mussels in the mid 1980s, but adult mussel quality was relatively inferior and harvesting ceased when the urchin fishery outside of Taunton Bay boomed.
- Poor mussel sets in Frenchmans Bay, gear conflicts with lobstermen, and downeast shellfish closures in 2003 prompted drag fishermen to employ hand-raking techniques in Taunton Bay. At least one crew worked from skiffs throughout the late summer-winter to collect mussels, which were transported to a waiting vessel for processing and transport. While the intensity of bottom disturbance incurred during this practice is unknown, it appeared that the area of seabed that was raked over a 24-hour period was comparable to what would result from one day’s worth of dragging.
- Dragging and diving for shellfish likely played a role in driving at least two species (urchins and scallops) to commercial extinction. Likewise, the re-

emergence of hand-raking suggests that harvest methods other than dragging warrant scrutiny if seabed alteration is a primary concern.

Specific Ecological Features

Eelgrass Distributional Change Analysis

When compared to non-vegetated substrates, eelgrass (*Zostera marina*) beds have been reported to harbor communities of disproportionately high complexity (see Thayer et al. 1984, for a review). Eelgrass also acts to collect and stabilize fine sediments that would otherwise be subject to erosional forces. Fishing methods such as dragging, which disturb sediment below the seabed, can damage eelgrass roots and rhizomes, leading to plant mortality. Recent research indicates that this damage can require, on average, 10.6 years (range: 6 to >20 years) of recovery time for drag-caused scars in grass beds (Neckles et al. in review). If newly unvegetated areas are sufficiently large that erosional forces create (or worsen) turbid conditions, declining light levels may inhibit or prevent subsequent eelgrass growth (Backman and Barilotti 1976). In light of 1) the potential role of eelgrass in influencing the Bay's ecology, 2) reports that dramatic declines in grass beds had recently occurred, and 3) the vulnerability of eelgrass to dragging, we set out to characterize the status of eelgrass in Taunton Bay. Our use of photography from 1996 and 2002 allowed comparisons in eelgrass coverage from both years. Findings are summarized below:



- Eelgrass coverage (acres) in the Bay had declined about 90% between 1996 and 2002. Reports from local experts suggest that the bulk of this loss may have occurred between 2000 and 2002. Mechanisms/processes driving the decline are unknown.
- Rapid losses at another Maine coast site have been noted recently (Seth Barker, DMR, unpublished data), but the trend of overall decline in Taunton Bay, without concomitant gains that might balance these losses, suggests that Taunton Bay is undergoing a dramatic period of ecological change.
- Archival photography and interviews with long-time residents indicated that Taunton Bay's eelgrass has waxed and waned in the past, but the amount of time between datasets hinders attempts to reconstruct historic trends in the Bay's eelgrass distribution.
- The ecological importance of eelgrass and likely protracted recovery times of drag-impacted grass beds provide compelling arguments against large-scale

human-induced seabed disturbances in Taunton Bay's shallow subtidal flats, especially in light of recent declines.

Intertidal Community Characterizations

Both subtidal and intertidal areas are subject to dragging. An understanding of community structure in these environments is required if vulnerability and response to dragging can be assessed. Intertidal communities can support diverse species assemblages depending on geographic location, substrate, wave exposure, tidal amplitude, and salinity, among other factors. With our limited time and resources, we chose to examine one type of intertidal environment to characterize seasonal community structure. Our methods involved sampling rockweed beds in the upper and lower Bay over the course of one year. Summarized findings are as follows:

- Species richness was somewhat lower in Taunton Bay than other Frenchman Bay sites, especially in northern reaches of the Bay. Within the lower Bay, richness values among sites were similar. No unique or otherwise uncommon assemblages of species were observed.
- Taunton Bay's apparently high sediment load or other stress factors may be responsible for the depauperate faunal assemblage we observed, but it is important to note that the short sampling period (about 9 months) may not have allowed a species diversity estimate that was representative of most years.
- If suspended sediment levels do limit this system, frequent dragging on the flats may exacerbate this problem, especially if sediment-stabilizing organisms such as eelgrass and mussels are removed.

Horseshoe Crab Seasonal Movements

The Atlantic horseshoe crab (*Limulus polyphemus*) ranges from the Yucatan to the northwest Atlantic Coast. Current documentation indicates that Taunton Bay represents the extreme northern limit of the species. Unlike other regions, Maine's horseshoe crab breeding areas comprise relatively small pockets along the coast. Whereas mid-Atlantic breeding aggregations may number in the millions, Maine's might comprise tens of thousands, and in some areas less. Although numbers are uncertain, Taunton Bay likely represents one of these smaller populations. In addition, mounting genetic evidence suggests that these crabs may also be isolated from other populations (Tim King, USGS, pers. comm.). Horseshoe crabs in Taunton Bay may therefore be at an increased risk of local extinction associated with over harvesting or unpredictable environmental,

demographic, or genetic events that would be more easily sustained by larger populations (Ruggerio et al. 1994, Thomas 1994, Lopez and Pfister 2001).

The ecological role of horseshoe crabs is not well-understood, although where crabs occur in substantial numbers, they no doubt influence benthic communities through the removal of prey organisms and their characteristic “plowing” of the sediment. Given the unique nature of Taunton Bay’s horseshoe crab population, we set out to identify seasonal movement patterns in the species. With this information, we hoped to determine the likelihood of overlap between crab habitat and areas targeted by drag fisheries, as it was assumed that interactions with drags could result in productivity-limiting stress or mortality. Our study will continue though early summer 2004, but summary findings after tracking 26 crabs with sonic telemetry from 16 June-24 November 2003, are as follows:

- Early-season movements from our two core breeding sites (Egypt and Hog Bay) were variable but typified by high mobility, with some crabs ranging as far as one mile three weeks after tagging.
- Broad patterns of early-season use of intertidal v. subtidal areas were variable.
- Mid-late season was marked by a dramatic reduction in mobility and an apparent preference for subtidal areas. In Hog Bay, the limited amount of subtidal seabed tended to aggregate crabs during that timeframe, thus heightening their vulnerability to perturbations or stresses in these areas.
- Throughout June-November tracking, crabs used both shallow subtidal flats and channels, but rarely strayed far from their breeding sites. If these findings are assumed to represent the long-term trend in resource use, the basins surrounding core breeding areas represent important, perhaps critical habitat - at least for the post-breeding half of the year. If draggers fished these waters during the post-breeding season, interactions with crabs would be likely. Aside from potential stress or injuries incurred by coming in contact with the drag, the short-term consequences of dragging (e.g. reduced prey densities and diversity) in these areas may also be inconsistent with effective horseshoe crab management.
- The unique nature of this group of crabs, which may be geographically and genetically isolated from other populations, probably warrants the implementation of special protection measures beyond the dragging issue. Our work suggests that novel human activities in breeding/post breeding areas should be scrutinized especially critically for consistency with horseshoe crab management objectives.

Shallow Subtidal Fish Communities

South of Maine, Eelgrass (*Zostera marina*) beds have often been reported to harbor communities of disproportionately high complexity (refer to Thayer et al. 1984, for a review). Whereas Taunton Bay has been known to historically support extensive eelgrass beds, and these areas might be subject to alteration should the current dragging prohibition be rescinded, we attempted to determine the functional role of eelgrass as it related to finfish community structure in the Bay. We sampled June-November, 2002 and April-October, 2003 with a 6.6-foot (2 m) beam trawl at sites of dense eelgrass growth around the Bay and adjacent areas that were primarily unvegetated. Summarized findings are provided below:

- Species richness and abundances in eelgrass were dramatically higher than was the case in adjacent unvegetated flats.
- Eelgrass declines in 2003 demonstrated that affected plots supported fewer species and reduced abundances than plots with stable grass beds.
- The periodicity and causes of Taunton Bay's historic eelgrass declines is uncertain, but even if decadal-scale losses represent the average interval of sweeping change in this community type, dragging-induced eelgrass disturbance could represent a significant threat to community stability. If a sufficient amount of seabed is disturbed, the stability of other communities could too be jeopardized, as changes in eelgrass-associated species may initiate an unpredictable cascade of population shifts throughout the Bay.

Shallow Subtidal Mussel Dragging Experiment

Disturbance of the seabed by bottom-tending, mobile fishing gear has increasingly raised concerns regarding the sustainability of these activities. As a result, numerous studies have investigated the effects that various trawl and dredge fisheries exert on ocean environments (see Watling and Norse 1998, Hall 1999, and Collie et al. 2000, for reviews). However, because mussel dragging has been subject to little research effort, we attempted to characterize the effects of dragging on a shallow, subtidal mud bottom, in a way that closely

approximated an actual harvest situation. We also described seasonal change in un-dragged study plots to evaluate background levels of variability and change in this shallow environment. Summarized findings are provided below:

- Our shallow subtidal benthic community appeared fairly dynamic in terms of seasonal shifts in community composition and sporadic appearances of species for only one season at a given plot.
- Several species representative of community assemblages south of Cape Cod were observed. Along with the presence of horseshoe crabs, this suggests that conditions in Taunton Bay are relatively unique among other Maine embayments.
- Dragging represented an alteration to the seabed that at least in the short term (perhaps several months), caused a significant shift in community composition.
- Longer term, lingering effects were less clear, although dragging may have had a destabilizing effect that persisted in the drag plot, which often demonstrated higher between-season community dissimilarity than control plots. However, the effects ice, wind, or other factors on the various plots were not measured and might also have influenced longer-term community changes.
- Along with results from other research, our findings shed light on several issues where dragging is concerned: 1) dramatic short-term benthic community declines resulted from a single dragging event over unvegetated substrate, 2) in eelgrass dominated areas, dragging probably causes longer-term (decadal-scale) changes, 3) large-scale removal of mussels could lead to a loss of sediment stability and filter-feeding capacity of the benthos. Among other consequences, these changes may facilitate increased turbidity levels, which could exacerbate current eelgrass declines.

CONCLUSIONS AND RECOMMENDATIONS

Our efforts demonstrated that unchecked dragging has the potential to deplete target species and negatively impact habitats and populations associated with the benthic environment. We also found that the re-emergence of hand-raking as an alternative subtidal mussel harvesting method warrants an evaluation of that activity's ecological consequences. Despite demonstrated and potential impacts associated with dragging and other seabed-disturbing activities, limited use of these harvesting methods may nevertheless be consistent with effective management of Taunton Bay's natural resources. However, if management goals for Taunton Bay focus on sustained ecological health and resource extraction, a well-developed management plan that considers where, when, and how often these activities occur will be required. Whereas dragging effort in Taunton Bay has historically been limited, it is unlikely that local families would incur significant negative economic impact as a result of such a plan.

Our work in Taunton Bay demonstrated the value and feasibility of a science-based response to an emerging resource-use issue. As a next step, development of a comprehensive, area-specific management plan for Taunton Bay would seem warranted and predisposed to success, given the Bay's strong and diverse constituency, relatively small and isolated physical area, and the prior completion of several necessary ecological characterization components.

To conclude, we make the following recommendations:

1) Continue the prohibition on unrestricted bottom dragging in Taunton Bay.

2) Develop a science-based comprehensive resource management plan that addresses principal resource user groups in the context of sustaining ecological processes, functions, and values of Taunton Bay.

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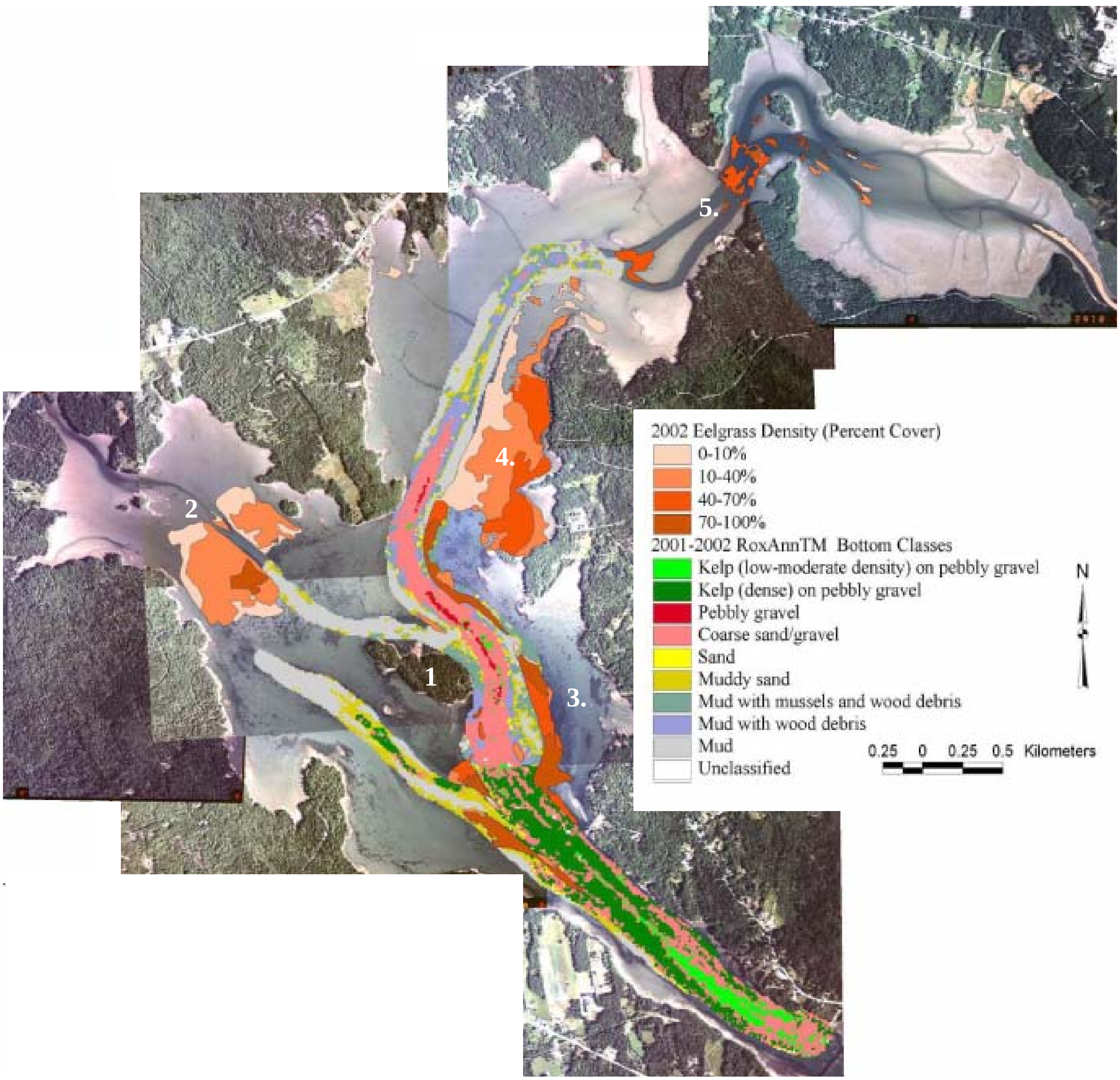
Appendix A. Taunton Bay Seabed Mapping, 2001-2002. Dominant trends in the map indicate that the channel bottom north of Burying Island (1) grades towards coarser material from north to south. South of Burying Island, channel velocities apparently keep fines from settling on the seabed, which is also dominated by kelp growth. Primary areas of eelgrass growth are restricted Egypt Bay (2), the flats adjacent to the east channel bank across from Burying Island (3), the flats east of the channel near Butler Point (4), and scattered pockets in the main channel near Dwelley Point (5).



Appendix B. Taunton Bay Assessment field study locations. Red rings indicate horseshoe crab tagging sites. Blue circles denote intertidal characterization sites. Larger, green circles signify fish community trawl plots. The light-shaded area near the center of the Bay indicates the dragging experiment location. Eelgrass and seabed field characterizations were bay-wide.